the relative proportions of the limb-bones, especially in the shortness of the humerus compared with the fore-arm, and in the form of the pelvis, Negro affinities are most strongly indicated.

In speaking of the culture of the Andamanese, of course I only refer to their condition before the introduction of European civilization into the islands. They live in small villages or encampments, in dwellings of simple and rude construction, built only of branches and leaves of trees. They are entirely ignorant of agriculture, and keep no poultry or domestic animals. They make rude pots of clay, sun-dried, or partially baked in the fire, but these are hand-made, as they are ignorant of the use of the potter's wheel. Their clothing is of the scantiest description, and what little they have chiefly serves for decorative or ornamental purposes, and not for keeping the body warm. They make no use of the skins of animals. They have fairly well-made dug-out canoes and outriggers, but only fit for navigating the numerous creeks and straits between the islands, and not for voyages in the open sea. They are expert swimmers and divers. Though constantly using fire, they are quite ignorant of the art of producing it, and have to expend much care and labour in keeping up a constant supply of burning or smouldering wood. They are ignorant of all metals; but for domestic purposes make great use of shells, especially a species of *Cyrene* found abundantly on the shores of the islands, also quartz chips and flakes, and bamboo knives. They have stone anvils and hammers, and they make good string from vegetable fibres, as well as baskets, fishing-nets, sleeping-mats, &c. Their principal weapons are the bow and arrow, in the use of which they are particularly skilful. They have harpoons for killing turtle and fish, but no kind of shield or breastplate for defence when fighting. The natural fertility of the island supplies them with abundance and a great variety of food all the year round, the purveying of which affords occupation and amusement for the greater part of the male population. This consists of pigs (*Sus andamanensis*), which are numerous on the islands, paradoxurus, dugong, and occasionally porpoise, iguanas, turtles, turtles' eggs, many kinds of fish, prawns, mollusks, larvæ of large wood-boring and burrowing beetles, honey, and numerous roots (as yams), fruits, and seeds. The food is invariably cooked before eating, and generally taken when extremely hot. They were ignorant of all stimulants or intoxicating drinks—in fact, water was their only beverage; and tobacco, or any substitute for it, was quite unknown till introduced by Europeans.

(*To be continued.*)

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE Institution of Mechanical Engineers held its annual meeting at the house of the Institution of Civil Engineers in Great George Street, Westminster, on the 3rd and 4th inst., under the presidency of Mr. E. H. Carbutt.

The papers brought forward for reading and discussion were: the Third Report of the Research Committee of the Institution on Friction; "Description of the Emery Testing Machine," by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A.; and "Supplementary Paper on the Use of Petroleum Refuse as Fuel in Locomotive Engines," by Mr. Thomas Urquhart, Locomotive Superintendent, Grazi and Tsaritsin Railway, South-East Russia; the third of which was deferred till the next meeting of the Institute.

The third report of the Friction Committee is on experiments on the friction of a collar-bearing. The general conclusions of the Committee are that this kind of bearing is inferior to a cylindrical journal in weight-carrying power. The coefficient of friction is also much higher than for a cylindrical bearing, and the friction follows the law of the friction of solids more nearly than that of liquids, due doubtless to the less perfect lubrication applicable to this form of bearing compared with a cylindrical one. The coefficient of friction appears to be independent of the speed, but to diminish somewhat as the load is increased, and may be stated approximately at $\frac{1}{20}$ at 15 lbs. per square inch, diminishing to $\frac{1}{30}$ at 75 lbs. per square inch.

In the broad principles of construction on which the Emery system of testing and weighing machinery rests are included two radically new and highly important elements—namely, an arrangement of hydraulic chambers and diaphragms capable of receiving without injury pressures and shocks of great intensity, and of transmitting them simultaneously, without loss from friction, to a convenient point for the purpose of measuring and recording them, and capable also of reducing them to such lower term of degree as may be desirable; and a means for flexibly uniting a vibrating scale-beam either to a fixed abutment or to another beam of the same system, in such a manner as absolutely to eliminate friction, and to preserve indefinitely the fulcrum intervals or distances precisely as first adjusted, and to resist and transmit all the pressures and shocks to which the fulcrums are subjected, without in the slightest degree impairing their sensitiveness or durability.

The hydraulic construction is such that through it the strain on the specimen is transmitted without loss to a hydraulic chamber containing a thin film of liquid, which is again transmitted through a small copper tube, without loss from friction or otherwise, to a much smaller chamber containing a similar thin film of liquid. The acting area of the liquid in the smaller chamber is less than that in the larger in the proportion in which the load on the specimen is desired to be reduced before it is received upon the beams in the scale-case where it is measured. In the scale-case containing the weighing mechanism, the pressure transmitted from the smaller chamber is received at one end of a system of levers, and measured by means of devices which are shown in detail in the figures which accompanied the paper.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Among the courses of lectures announced for this Term we may notice the following:—

In Physics, Prof. Clifton is lecturing on Optical Properties of Crystals, and Mr. Selby on Absolute Electrical Units, at the Clarendon Laboratory. At Christ Church, Mr. Baynes lectures on Thermo-dynamics, and on the Transfer of Energy in an Electro-magnetic Field.

The University has made a grant to Mr. Smith, in aid of the Millard Engineering Laboratory, and practical work on the physical basis of engineering is regularly carried on there.

In Chemistry, besides the usual courses, Mr. Veley is lecturing on Thermo-chemistry, and Mr. Marsh on Recent Organic Research.

The work of the Geological Chair is at present being done by Mr. W. W. Watts (M.A. Camb.), who is lecturing for a term in order that Prof. Green may complete his session at the Yorkshire College.

Owing to Prof. Moseley's continued illness, Dr. Hickson is still acting as Deputy Linacre Professor, and is lecturing on the Morphology of the Chordata. Mr. Bourne, who is to assume his post as Superintendent of the Plymouth Marine Station in a month, is lecturing on Embryology, and Prof. Westwood on the Winged Arthropoda.

Dr. Burdon-Sanderson lectures this Term on Nutrition, and Dr. Gilbert on the Rotation of Crops.

In the absence of any Professor of Botany, Mr. J. B. Farmer is conducting the necessary elementary courses.

CAMBRIDGE.—Prof. Adams is appointed one of the four representatives of Cambridge at the 800th anniversary of the foundation of the University of Bologna, in June next.

An additional class-room for students of Mineralogy is to be formed.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 19.—"The Radio-Micrometer." By C. V. Boys.

The author gave the result of a mathematical investigation made with a view to arrive at the best possible construction of the radio-micrometer already described by him. At the conclusion of the meeting he showed in action an instrument which he had made, having the best proportions, which was both simpler in construction and far more sensitive than the one he exhibited on a previous occasion.

"On the Compounds of Ammonia with Selenium Dioxide." By Sir Charles A. Cameron, M.D., F.R.C.S.I., and John Macallan, F.I.C.

On passing dry ammonia into a solution of selenium dioxide in absolute alcohol, a compound is formed to which the authors have assigned the name ammonium selenosamate, and the formula NH_4,SeO_2NH_2. It is the ammonium salt of a new acid; namely, H,SeO_2NH_2. It is unstable, continuously evolving ammonia, and ultimately becoming a stable acid salt, $NH_4,H,(SeO_2NH_2)_2$. The neutral salt forms hexagonal prisms and pyramids, and the acid forms prismatic crystals. The neutral salt dissolves in 116 parts of alcoholic ammonia, but is decomposed by absolute alcohol or by water.

April 26.—"On the Modifications of the First and Second Visceral Arches, with especial Reference to the Homologies of the Auditory Ossicles." By Hans Gadow, Ph.D., M.A., Strickland Curator and Lecturer on Comparative Anatomy in the University of Cambridge. Communicated by Prof. M. Foster, Sec. R.S.

The phylogenetic development of the first two visceral arches shows us some most interesting changes of function, which we can follow upwards from the lower Selachians to the highest Mammals.

Originally entirely devoted to respiration as gill-bearing structures, the whole hyoidean arch becomes soon a factor in the alimentary system. Its proximal half forms the hinge of the masticatory apparatus, its distal half remains henceforth connected with the process of deglutition. Then this suspensorial arrangement is superseded by a new modification; the hyomandibula is set free and would disappear (it does nearly do so in Dipnoi and certain Urodela), unless it were made use of for a new function; with its having entered the service of the conduction of sound, it has entered upon a new departure, and it is saved from degeneration. The whole system of the one to four elements of the middle ear, which all have the same function as conductors of sound, is to be looked upon as *one* organ of *one* common origin,—namely, as a modification of the hyomandibula, the primitive proximal paramere of the second visceral arch.

Successive Modifications of the Mandibular and Hyoidean Visceral Arches.

I. Primitive condition (Notidanidæ). The palato quadrate bar alone carries the mandible. The second arch is indifferent. Hyomandibula and quadrate (the palatine part is an outgrowth) are both attached to the cranium.

II. The hyomandibula gains a fibro cartilaginous connection with the mandible, the masticatory apparatus becomes amphistylic and occasionally hyostylic (Rajidæ, most Selachians).

The hyoid gains a cranial attachment (many Rajidæ).

III. The quadrate or autostylic suspensorium becomes preponderant; the hyomandibula is, as in Teleosteans, divided into a proximal and into a distal (symplectic) element. The proximal part is received into a fenestra of the otic capsule, and is converted into a stapes, whilst the distal half either remains (*Proteus*, *Siren*, *Menopoma*) or is lost (other Urodela). The whole hyomandibula would have been lost owing to its excalation from suspensorial functions, unless it had entered the auditory service.

IV. The autostylic arrangement prevails. The whole hyomandibula remains, gains an attachment on the "tympanum" and differentiates itself into several conjointed pieces, notably stapes or columella proper, and extra-columella or malleus.

The extra-columella gains connection with the parotic cartilage; this connection frequently remains, but in *Anura* alone it conatins a special element of probably parotic origin.

The quadrate forms an important part of the tympanic frame.

IV*a*. Collateral departure of the *Anura*. The connection between the tympanal part of the hyomandibula with the mandible is lost.

V. The quadrate still forms the principal suspensorial part of the mandible. The extra-columella, or malleus, retains for a long time its previously acquired connection with Meckel's cartilage (*Amniota*).

V*a*. The top end of the hyoid is attached to the cranium (*Geckos*, *Mammalia*), and is occasionally fused with the extra-columella (*Hatteria*).

V*b*. Or, the proximal portion of the hyoid is removed from the skull and remains otherwise well developed (*most Lizards*); or its proximal portion becomes reduced and lost (*Chelonia*, *Crocodilia*, *Ophidia*, *Aves*).

V*c*. The extra-columella gains an attachment to the quadrate, squamosal, or pterygoid, whilst its connections with the mandible (*Ophidia*, *Chamæleon*), and the tympanum, are lost.

VI. The quadrate gradually loses its articulation with the mandible; the latter gains a new outer articulation with the squamosal; the quadrate acts almost entirely as a tympanic frame. Incus and malleus fuse sometimes with each other, and lean on to the parotic region. The masticatory joint is doubly concave-convex (*Monotremata*).

VII. The quadrate is converted into the principal part of the tympanic frame, viz. annulus tympanicus. The mandible has lost its articulation with the quadrate, and the masticatory joint is a single concave-convex one, the convexity belonging to the mandible (*Monodelphia*).

EDINBURGH.

Royal Society, April 2.—Rev. Prof. Flint, Vice-President, in the chair.—Prof. Crum Brown communicated a paper by Dr. Prafulla Chandra Rây on the conjugated sulphates of the copper-magnesium group.—Dr. John Murray read a paper by Mr. A. Dickie on the chemical analysis of water from the Clyde area.—Sir W. Turner read a paper by Prof. His on the principles of animal morphology.—Prof. Tait communicated two mathematical notes.

April 16.—Prof. Chrystal, Vice-President, in the chair.—Dr. Buchan gave an analysis of the *Challenger* meteorological observations, pointing out various important meteorological conditions the existence of which had been revealed by the work of the *Challenger* Expedition.—Dr. John Murray read a description of the rocks of the Island of Malta, comparing them with deep-sea deposits.—Prof. Chrystal described an electrical method of reversing deep-sea thermometers.—Dr. Thomas Muir read a paper on a class of alternants expressible in terms of simple alternants.—Prof. Tait communicated a quaternion note.

PARIS.

Academy of Sciences, April 30.—M. Janssen, President, in the chair.—On the consequences of the equality assumed to exist between the true and the mean value of a polynome, by M. J. Bertrand. The author shows by a rigorous demonstration that the rule is not justified which gives *a posteriori* the precise value of a system of observations, although this rule is frequently applied with complete confidence in its accuracy.—On the theory of the figure of the earth, by M. Maurice Lévy. The point here mainly discussed is the difficulty of establishing a satisfactory agreement between the theory of fluidity and that of precession in connection with Clairaut's differential equation and the subsequent researches of Lipschitz inserted in vol. lxii. of the *Journal de Crelle*.—Remarks in connection with Père Dechevrens' recent note on the ascending movement of the air in cyclones, by M. H. Faye. In order to solve by direct observation the question of the ascending or descending movement of the atmosphere in cyclones, Père Dechevrens has devised a special anemometer for his observatory of Zi-Ka-Wei in China. But he suggests that more trustworthy results might perhaps be obtained by fitting up a similar apparatus at a greater elevation from the ground; for instance, on the top of Eiffel's Tower, 300 metres high, now being erected in Paris. M. Faye accepts this suggestion, confident that, if carried out, it cannot fail to confirm his own views on the movement of the atmospheric currents in cyclones.—An elementary proof of Dirichlet's theorem on arithmetical progressions in cases where the ratio is 8 or 12, by Prof. Sylvester. In this demonstration the author starts from the following principle: To show that the number of prime numbers of a given form is infinite, let an infinite progression be constructed of integers relatively prime to each other, and each containing a prime number at least of the given form.—Distribution in latitude of the solar phenomena recorded during the year 1887, by M. P. Tacchini. A table is given of the spots, eruptions, faculæ, protuberances, as observed in each zone of 10° in the two solar hemispheres. The hydrogenic protuberances occur in all the zones, whereas the other phenomena were almost entirely restricted to the central region between 0° and ± 40°, as in the previous year. The spots, faculæ, and metallic eruptions present an agreement in the respective zones of maximum frequency between 0° and ± 20°; a maximum for each of the three orders of phenomena corresponds to the zone 0°–10° exactly as in 1886. The spots were confined to the equatorial zone (+30°–20°); the eruptions and the faculæ occurred at much higher latitudes, in fact as far as +50° and −60°. Hence there are zones with faculæ and eruptions, but without spots, while on a great part of the solar surface hydrogenic protuberances are observed in the total absence of spots.—In a second communication, M. Tacchini gives a summary of the solar observations made at Rome during the first quarter of the year

1888. From this summary it appears that the phenomena of spots and faculæ still continue to decrease, while the protuberances have increased. This confirms the remark already made that there is no close relation between these two orders of phenomena.—Determination of the heats of combustion of the isomerous acids corresponding to the formulas $C_4H_4O_4$ and $C_5H_6O_4$, by M. W. Louguinine. The constituent formulas of the fumaric and pyromalic, as well as of the mesaconic, citraconic, and itaconic acids have been the subject of frequent discussions amongst chemists. In order to throw some light on these obscure questions, the author here determines the heats of combustion of the acids in question. He concludes generally that fumaric differs greatly from pyromalic acid, the former being the lower homologue of one of the three acids with formula $C_5H_6O_4$. The formulas corresponding to these three acids are evidently closely related, the difference here being of quite another order from that which exists between the formulas corresponding to the fumaric and pyromalic acids.—On the slow combustion of certain organic substances, by M. Th. Schlœsing. The author's experiments with tobacco seem to show that the combustion arising in heaps of foliage, hay, and the like is in the first instance due to the action of micro-organisms, but with the increase of temperature it gradually assumes a purely chemical character. The influence of living organisms appears to cease between 40° and 50° C., after which the chemical action rapidly increases.

BERLIN.

Meteorological Society, April 10.—Dr. Vettin, President, in the chair.—Dr. Zenker communicated the second part of his research on the distribution of heat over the earth's surface. In the first part, of which he had spoken at the last meeting of the Society, he had shown that the distribution of heat depends not only upon the radiation from the sun and absorption by the atmosphere, but additionally upon the nature of the earth's surface, whether it is land or water. In previous researches on the distribution of heat, the mean values were determined from and based upon empirical observations; Dr. Zenker, on the other hand, has calculated the distribution of heat over the surface of the sea with the help of Hann's isothermal charts, starting with the temperature of a point on its surface which was quite uninfluenced by the neighbouring continents, and was consequently equally unaffected by any warm or cold currents. Using this factor, and the formulæ deduced in the theoretical part of his paper, he has calculated the distribution of heat from the pole to the equator for each successive parallel, and compared it with the distribution of solar radiation. As a basis for the distribution of heat over the surface of the land, it was first necessary to determine the conditions under which the influence of the neighbouring sea is either nothing or minimal in amount. The starting-point for this was the fact that the temperatures on continents exhibit very great variations, and from these was determined for each area, as a percentage, the relative influences of the sea and continent upon its temperature. The region where the influence of the sea was proved to be nil (or where, as the speaker said, the "continentality" was 100 per cent.) was in the neighbourhood of the east coast of Asia, whereas all other points were found to be affected by the neighbouring sea to a greater extent; the observed temperature on the land was therefore only partly dependent upon the position of the place on any given parallel, other influences making themselves more or less felt. Hence it was possible to calculate for each parallel the real and "accessory" temperature. The amount of heat radiated down from the sun was compared with these temperatures, and was found to be about the same for each 10° C. of difference in temperature; from 0°–10° C., however, quite considerable differences of radiation were necessary. In conclusion, Dr. Zenker compared the temperatures which really exist on the earth's surface with those which he had deduced, and found that in reality the climate on the sea of the southern hemisphere is colder than it should be according to calculation—a result which must be attributed to the oceanic currents of cold water. The continental climate in the northern hemisphere is slightly too warm, in consequence of the disturbance introduced by the Gulf Stream.—Lieutenant Moedebeck gave an account of a balloon journey which he made on March 31. The marked phenomenon during the same was the influence of rivers; thus, after the balloon had risen to a height of 300–500 metres, and was passing away over Berlin, it sank so rapidly over the Spree that when it was about 50 metres above the earth a large quantity of ballast had to be thrown out. At an elevation of 1200 metres he met with a long narrow rain-cloud, in passing through which the dry-bulb thermometer registered 1°·5 C., the wet-bulb 1° C.; at an elevation of 1300–1400 metres, both thermometers recorded the same temperature of 2°·5 C. At this height, and in circumscribed areas, a few very small semi-soft hailstones were observed. Shortly after this the balloon began to sink, and while still above the cloud, but at a lower level, somewhat larger but similar hailstones were observed for the second time. As soon as the balloon had passed through the cloud, rain fell for a short time, as the result of which the balloon was so weighted that it descended rapidly to the earth. The atmosphere above the cloud was not clear but rather misty.

BOOKS, PAMPHLETS, and SERIALS RECEIVED FOR REVIEW.

Land and Fresh-water Mollusca of India, Parts 1 to 6, and plates: Lieut.-Col. H. H. Godwin Austen (Taylor and Francis).—Botany for Beginners, 4th edition: Rev. Prof. G. Henslow (Stanford).—Botany of the Afghan Delimitation Commission (Linnean Society): J. E. T. Aitchison (Longmans).—Report on the Meteorology of India in 1886: J. Eliot (Calcutta).—Indian Meteorological Memoirs, vol. iv. part 4 (Calcutta).—Memoirs on the Winds and Monsoons of the Arabian Sea and North Indian Ocean: W. L. Dallas (Calcutta).—A Short Text-book of Electricity and Magnetism: T. Dunman (Ward, Lock, and Co.).—A Short Text-book of Sound, Light, and Heat: T. Dunman (Ward, Lock, and Co.).—A Life of Matthew Fontaine Maury: D. F. M. Corbin (Low).—An Illustrated Manual of British Birds, part 2: H. Saunders (Gurney and Jackson).—Bibliothek der Gesellschaft für Erdkunde zu Berlin (Berlin).—Essai de Définition et de Nomenclature; Les Dislocations de l'écorce Terrestre: E. de Margerie and Dr. A. Heim (Zurich).—Nature's Fairy Land: H. W. S. Worsley-Benison (Stock).—Evolution and its Relation to Religious Thought: J. Le Conte (Appleton, New York).—Record of Experiments conducted by the Commissioner of Agriculture in the Manufacture of Sugar from Sorghum and Sugar Canes, 1887–88 (Washington).—The Constants of Nature, 1st Supplement to Part 1: F. W. Clarke (Washington).—The Vegetable Resources of the West Indies: D. Morris (Silver).—Fruit: Dr. Crespi (Heywood).—Journal of the Royal Agricultural Society, April (Murray).—Quarterly Journal of Microscopical Science, April (Churchill).—Geological Magazine, May (Trübner).—Journal of the Society of Telegraph Engineers and Electricians, vol. xvii. No. 72 (Spon).—Schriften der Naturforschenden Gesellschaft in Danzig, Siebenter Band, Erstes Heft (Danzig).—Bulletin of the California Academy of Sciences, vol. ii. No. 8.

CONTENTS.

PAGE
Forms of Animal Life 25
The Cardinal Numbers 27

Our Book Shelf :—

Hampson: "The Romance of Mathematics" 28
"Wanderer": "Antipodean Notes"; and Freeman: "Lights and Shadows of Melbourne Life" 29

Letters to the Editor :—

The Salt Industry in the United States.—**Thomas Ward** 29
Prof. Rosenbusch's Work on Petrology.—**A. B.** 30
History of the Contraction Theory of Mountain Formation.—**Charles Davison** 30
Lightning and Milk.—**F. A. Bather** 30
The Duplex Pendulum Seismograph.—**Prof. J. A. Ewing** 30
Self-Induction.—**W. E. Sumpner** 30
Suggestions on the Classification of the Various Species of Heavenly Bodies. IV. (*Illustrated.*) **By J. Norman Lockyer, F.R.S.** 31
Three Days on the Summit of Mont Blanc. (*Illustrated.*) 35
The Photographic Chart of the Heavens 38
The Forth Bridge. (*Illustrated.*) 39
Flora of the Antarctic Islands. By W. T. Thiselton Dyer, C.M.G., F.R.S.; Dr. H. B. Guppy 40
Lord Hartington on Technical Education 40
Notes 41

Our Astronomical Column :—

New Minor Planets 43
Comet 1888 *a* (Sawerthal) 43
Cincinnati Zone Catalogue 43
Publications of Lick Observatory 43
Astronomical Phenomena for the Week 1888 May 13–19 43
The Pygmy Races of Men. I. By Prof. Flower, C.B., F.R.S. 44
The Institution of Mechanical Engineers 46
University and Educational Intelligence 46
Societies and Academies 46
Books, Pamphlets, and Serials Received for Review 48